The Seasonality Structure of Demand in the Portuguese Hotel Industry before the COVID-19 Pandemic

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To cite this article: Melo Maia, B. & Paralta, S. 2022. The Seasonality Structure of Demand in the Portuguese Hotel Industry before the COVID-19 Pandemic. European Review of Business Economics I(2): 99-127; DOI: https://doi.org/10.26619/ERBE-2021.I.2.5

ABSTRACT

The purpose of this paper is to study the monthly seasonality structure of demand in the hotel industry in continental Portugal before the outbreak of the COVID-19 pandemic in 2020. The tourism sector accounts for more than 10% of Portugal's GDP, as well as being a key factor for regional development and employment. Understanding the seasonality structure of the hotel sector provides useful insight about business viability and aids operational decisions, namely concerning the post-pandemic recovery. Therefore, we analyze time-series data collected from Statistics Portugal, concerning net bed occupancy rates for continental Portugal, as well as according to region and hotel category, for the pre-pandemic period between 2014 and 2019. This allows us to identify the seasonal peaks according to region and compare the differences in demand for hotels according to hotel category. We also analyze the relationship between the seasonality coefficients and the average income per night (room rate).

SEASONALITY IS AN IMPORTANT FACTOR that affects the demand of the different segments of the tourism industry, with a significant impact in terms of hotel operations (e.g., Chang et al., 2019; Butler, 1999). It is a phenomenon driven mostly by climatic, and institutional factors, such as school calendars and holidays. Among them, are school and work holidays, national holidays, religious and cultural celebrations, and climate conditions at touristic destinations.

The estimation of seasonal profiles is extremely important for designing and implementing operating strategies, namely, at the human resources, and marketing levels.

* The authors would like to express their gratitude to Prof. Mário Coutinho dos Santos and Prof. Victor Mendes for their valuable advice, guidance and suggestions that helped to improve this work. The authors would also like to thank Prof. Jorge Mota for his help concerning access to some databases. The authors are entirely responsible for any errors, omissions, and limitations of the present work. The authors have not received any kind of funding for this project. Sara is the corresponding author and can be reached at sparalta@iscsp.ulisboa.pt or sparalta@autonoma.pt.

The COVID-19 pandemic had an unprecedented impact on tourism activity in general, and on hotel activity in particular, causing a severe drop in demand for hotel services.

This disruption may have impacted the pre-pandemic seasonality patterns, which are the ones considered in this work. Despite its relevance, to our knowledge, there has been limited research on this topic, at least concerning the Portuguese hotel industry. This paper aims at addressing that gap.

The purpose of this work is to estimate the seasonal profiles of demand in the hotel industry in continental Portugal, prior to the COVID-19 pandemic.

We examine hotel occupancy rates between 2014 and 2019 (before the COVID-19 outbreak) in continental Portugal, as well as for hotels according to geographical region (NUTS-II), and hotel type in terms of star rating.

In this study, we perform a classical trend-cycle and seasonal coefficient decomposition of net for occupancy rate for continental Portugal, as well as for different geographical regions and according to hotel type. We also examine to what extent hoteliers actively try to adopt pricing strategies to mitigate the impact of seasonality on hotel revenue. To that end, we analyze Spearman's correlation between hotel occupancy rates and average income per overnight stay.

The rest of the paper is laid out as follows. Section I presents a brief review of the relevant literature. Section II describes the data used and Section III shows some descriptive statistics. The methodology is presented in Section IV. Section V shows the results of the calculation of the seasonal factors by region and by hotel type (star rating). It also displays the income calculated per overnight stay and the correlation between this variable and the seasonal factors. Section VI presents the conclusions.

I. Literature Review

The seasonal variation of hotel demand implies that hotel units will have low occupancy rates in the low seasons, that is, an inefficient usage of the installed hotel capacity. An even more important issue concerns the instability of the number of hotel staff required throughout the year, leading to variations in the demand for local employment in the tourism sector. The seasonal variation in the tourism sector also has an indirect impact on the distribution chain, transportation, and local commerce of products (Bar-On, 1999; Vrkljan et al., 2019). This means that the tourism sector seasonality poses a problem vis-à-vis employment stability, sustainable development, and economic growth (United Nations Sustainable Development Goal 8: sustainable tourism is one of the subtopics). One of the few advantages of the seasonal phenomenon in relation to hotel demand concerns the possibility of performing maintenance and construction refurbishment in the low season.

Local authorities and tourism businesses owners have tried to counteract the low tourism demand in the off-peak seasons. Some of the typical measures consist of marketing campaigns (small holiday promotional packages throughout the year; targeting domestic tourism; tailored offers for the academic or professional conference market); diversification of attractions (such as purposely built facilities, monuments, museums, and amusement parks); lowering prices in the off-peak season. Nonetheless, not much can be done in terms of the climate when it comes to snow or beach destinations.

Tourism seasonality in Portugal has not been thoroughly studied in terms of space, distribution of clients, quality of service offered, revenue, although some authors have studied the seasonality in Portugal or Mediterranean destinations, such as Duro (2016), Mitra (2020), Vrkljan et al. (2019), Neves et al. (2008), Gouveia (2014) and Vergori (2017). Some of these studies have some limitations as far as the implications of the scope or method used are concerned (Gouveia, 2014; Vergori, 2017). While Gouveia (2014) studied only British tourism demand in the Algarve, this author applied a graphical approach and structural break test procedure and identified two seasonal breaks, one in 1977 and another in 1991. Vergori (2017) studied the forecasting process of seasonality in four countries, including Portugal where one seasonality peak was detected, but the accuracy of the SARIMA forecasts revealed to be less accurate than for other countries, such as Austria and Finland, even using data from 1990 to 2014.

Previous studies have used different measures of seasonality. For instance, Neves et al. (2008) consider seasonal rates, seasonal range (amplitude), and seasonal indices. While the seasonal rate allows the intensity of seasonality towards the annual tourism demand to be measured, the seasonal range reveals the relative importance between the highest and lowest demand, the season indices give the intensity of the seasonality without the cycle and trend interferences. The empirical study performed used data from Porto Santo Island tourism between 1997 to 2002 and used an additive seasonal decomposition model to study the seasonal pattern. They concluded that the seasonality originated in the domestic market that represents most of the island's tourism demand.

II. Data Description

The empirical findings of this work rely on datasets collected from Statistics Portugal (INE). We considered existing hotels in continental Portugal, between 2014 and 2019. We did not consider the period before 2014, because Portugal went through a financial crisis between 2010 and 2014, during which time Portugal requested external financial assistance through an IMF-EU bailout package. The financial aid required the implementation of austerity measures, which strongly affected the economy during those years. We considered 2019 as the last year in our sample period, due to the COVID-19 pandemic outbreak in early 2020, which led to the declaration of a State of Emergency in the Portuguese territory, a compulsory lockdown in March and April, several restrictions to free movement in Portugal, closure of airports and increased border controls. All of this resulted in an unprecedented disruption in hotel operations, which almost came to a complete halt.

All data was obtained from the following databases available from Statistics Portugal: Bed occupancy net rate (%) in hotel establishments by Type (hotel establishment) – Monthly; Bed occupancy net rate (%) in tourist accommodation establishments by Geographic localization and Type (tourist accommodation establishment) – Monthly; Total revenue(€) of hotel establishments by Geographic localization (NUTS – 2013) – Monthly; Nights (No.) in hotel establishments by Geographic localization (NUTS – 2013) and Type (hotel establishment) – Monthly.

We measured hotel demand through hotel occupancy rate. We also considered the absolute number of overnight stays and total income, which allowed us to calculate average income per overnight stay, as a proxy for the daily room rate.

III. Empirical Results and Analysis

Table 1 shows the distribution of hotels in continental Portugal.

Table 1
Number of hotel establishments by geographic region

Year	North		Center		Lisbon		Alentejo		Algarve		Total
2014	275	28.0%	272	27.7%	225	22.9%	85	8.6%	126	12.8%	983
2015	297	29.0%	277	27.1%	237	23.1%	84	8.2%	129	12.6%	1024
2016	315	28.8%	304	27.8%	250	22.9%	88	8.1%	135	12.4%	1092
2017	326	28.2%	315	27.3%	270	23.4%	95	8.2%	148	12.8%	1154
2018	363	29.2%	344	27.7%	276	22.2%	101	8.1%	158	12.7%	1242
2019	380	29.5%	349	27.1%	291	22.6%	102	7.9%	164	12.8%	1286

Source: Statistics Portugal (INE)

The total number of hotels in the period from 2014 to 2019 increased by about 30 percent, which is explained by the economic recovery cycle following the

IMF-EU bailout package and the end of the austerity measures, as well as a general economic recovery in Europe. The distribution of hotels by geographic region remained approximately the same, percentage wise.

Table 2 details the number of hotels in continental Portugal for the same period, but distributed according to hotel type.

Table 2
Distribution of hotels by number of stars

Year	5-star		4-star		3-star		2-star		1-star		Total
2014	83	8.4%	292	29.7%	325	33.1%	263	26.8%	20	2.0%	983
2015	85	8.3%	317	31.0%	327	31.9%	272	26.6%	23	2.2%	1024
2016	91	8.3%	352	32.2%	337	30.9%	284	26.0%	28	2.6%	1092
2017	96	8.3%	380	32.9%	360	31.2%	289	25.0%	29	2.5%	1154
2018	103	8.3%	408	32.9%	383	30.8%	313	25.2%	35	2.8%	1242
2019	109	8.5%	437	34.0%	400	31.1%	305	23.7%	35	2.7%	1286

Source: Statistics Portugal (INE)

The distribution of the number of hotels by hotel type (number of stars), in percentage, remained approximately the same throughout the years from 2014 to 2019. Their total numbers increased, as already mentioned, due to the economic recovery cycle. 1-star category hotels represented a relatively small number, compared to the other hotel classes. It is worth mentioning that the number of existing hotels provides limited insight as far as seasonality is concerned, given that we are not considering their size, or capacity. About 90 percent of hotels are either 4, 3 and 2-star hotels, followed by the premium 5-star rated hotels.

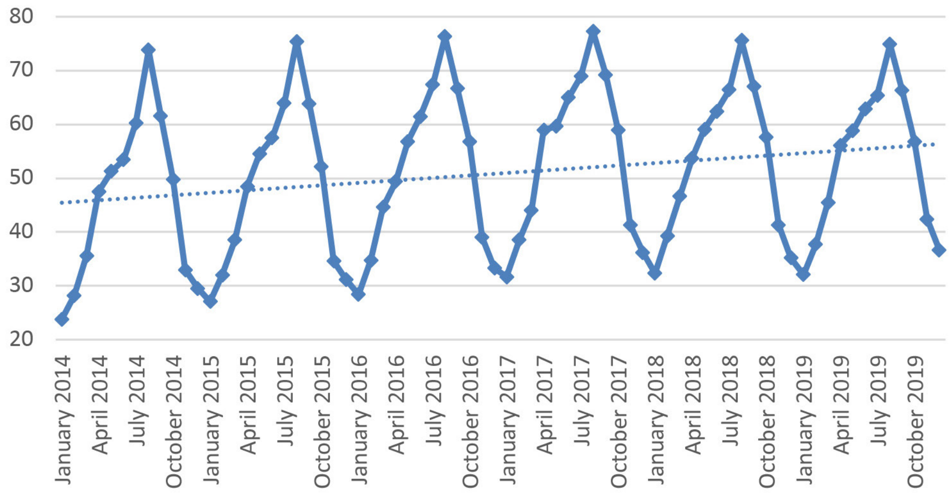
A. Hotel occupancy in continental Portugal

To measure hotel occupancy, we consider the metric ‘net bed occupancy rate’ that is the ratio between the number of occupied beds and the total number of available beds. For this purpose, we obtained the monthly time series of net bed occupancy rate for hotels in continental Portugal, between 2014 and 2019 (see Table 8, in the Appendix I) from INE. The plot of this time series is shown in Figure 1.

As expected, the plot documents the presence of a seasonal pattern. The dotted line indicates the ordinary least squares linear regression, which provides an estimate of the linear time-trend/cycle component of the time series.

For every year considered in the time series, the maximum monthly bed occupancy rates always occur in August, and the minimum occurs in January (see Table 3).

Figure 1
hotel occupancy in continental Portugal



Source: own research – data extracted from Statistics Portugal (INE)

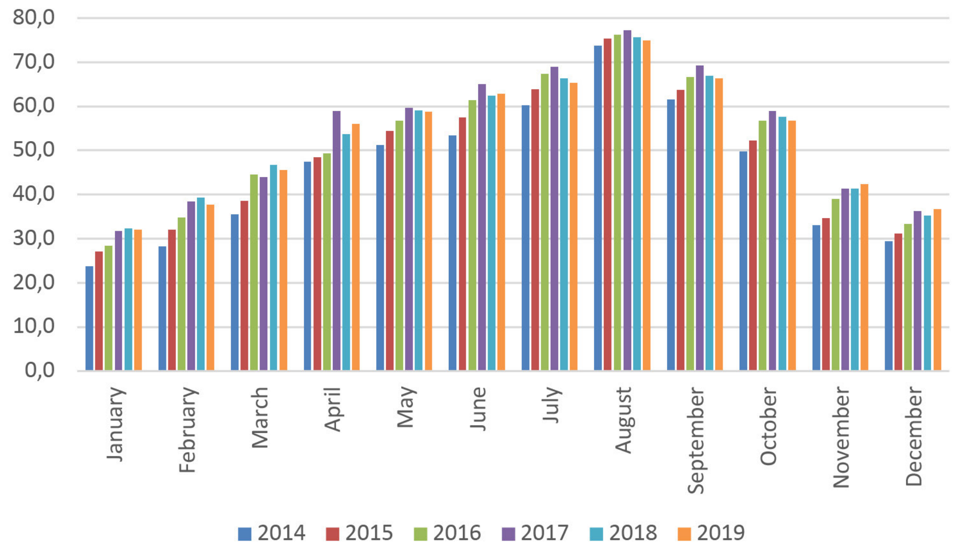
Table 3
Minimum and maximum bed occupancy rates (%)

year	Minimum (January)	Maximum (August)	Range (max-min)
2014	23.8	73.8	50.0
2015	27.1	75.4	48.3
2016	28.4	76.3	47.9
2017	31.7	77.3	45.6
2018	32.3	75.6	43.3
2019	32.1	74.9	42.8

Source: Statistics Portugal (INE)

It is also useful to look at the graphical representation of the monthly net bed occupancy, with a comparison between the six years under study. This is shown in Figure 2.

Figure 2
Monthly hotel occupancy rates (2014-2019)

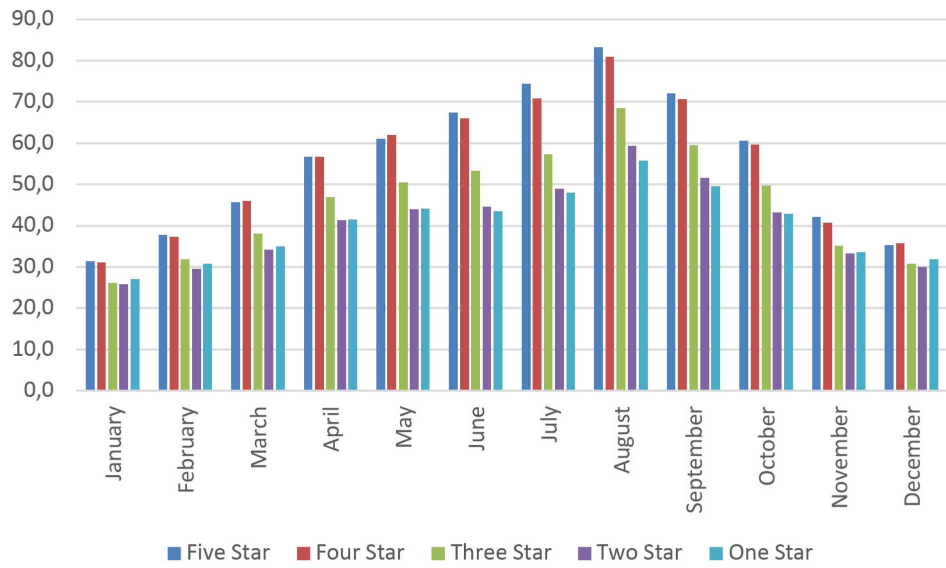


Source: own research – data extracted from Statistics Portugal (INE)

B. Hotel occupancy by number of stars

This dataset consists of five bed occupancy time series, one for each hotel type (or category), ranging from one to five-star classification. It is interesting to compare average monthly net bed occupancy according to hotel type. These figures are shown in Table 9 in the Appendix I, and the corresponding graph is shown in Figure 3.

Figure 3
Average monthly hotel occupancy, according to hotel type

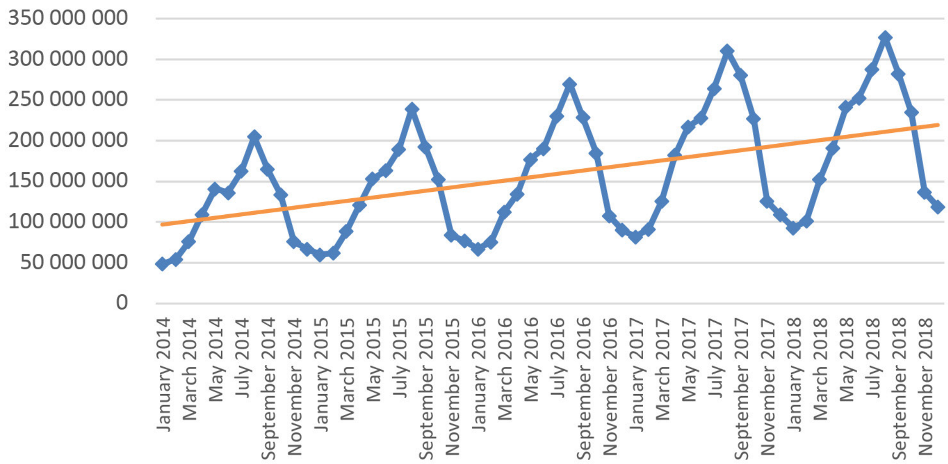


Source: own research – data extracted from Statistics Portugal (INE)

C. Total income and overnight stays

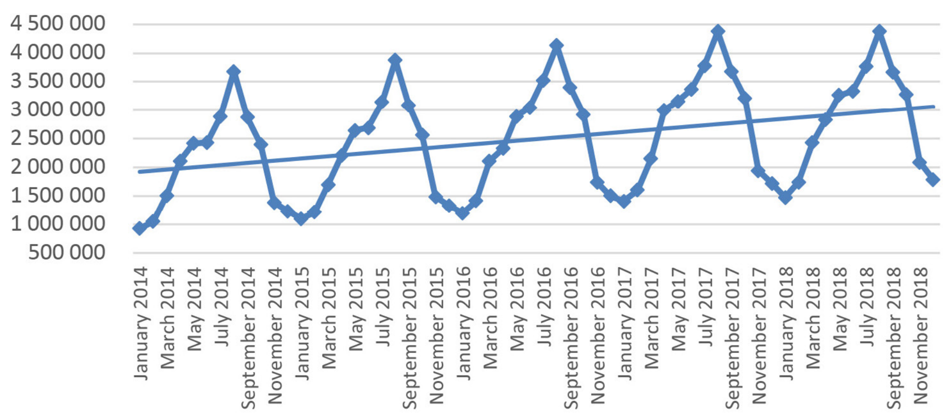
We also obtained the monthly time-series datasets of total income and of total overnight stays for hotels in continental Portugal, from 2014 to 2018, whose plots can be seen in Figure 4 and Figure 5 (the straight lines are the OLS regression lines, which can be interpreted as the linear trend-cycle component).

Figure 4
Total income (€) of hotels in continental Portugal



Source: Data from Statistics Portugal (INE)

Figure 5
Number of overnight stays in hotels in continental Portugal



Source: Data from Statistics Portugal (INE)

Hotel room daily rates can be estimated by the quotient between the total income and the total number of overnights stays. We calculated this ratio for every month for the years 2014 to 2018. This allows us to calculate the average monthly daily rate throughout these years, according to the NUTS-II geographic regions. This gives us information about the prices set by the hotel sector.

The ratio of the monthly income by the number of overnight stays generates the series of average monthly income per overnight stay. The averages of the monthly income per overnight stay for each given month, every year from 2014 to 2018, are shown in Table 4. There is a limitation on this procedure: a double or twin bedroom with two guests is counted as two overnight stays, whereas the same bedroom with one guest is counted as one overnight stay. If the room price is the same, the income per overnight stay would be lower for the room with two guests (higher demand) than for the room with one guest (lower demand). This is a limitation on our analysis, which may result in occasional arguable figures, but we still consider that it is worth following this approach, in the absence of alternative data without these limitations.

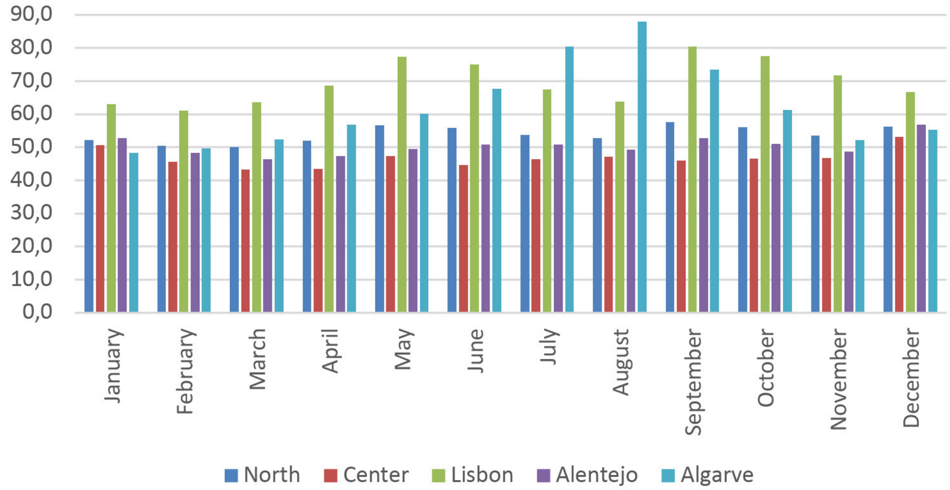
Table 4

Average monthly income (€) per overnight stay, between 2014 and 2018

Month	North	Center	Lisbon	Alentejo	Algarve	Continental Portugal
January	52.2	50.7	63.1	52.7	48.4	58.7
February	50.4	45.6	61.1	48.4	49.7	57.6
March	50.1	43.3	63.5	46.4	52.4	58.8
April	52.1	43.4	68.7	47.4	56.8	61.5
May	56.7	47.4	77.3	49.5	60.1	65.8
June	55.9	44.6	75.1	50.9	67.7	66.6
July	53.7	46.4	67.5	50.8	80.5	66.6
August	52.7	47.2	63.7	49.2	87.9	65.6
September	57.7	46.0	80.5	52.8	73.5	67.8
October	56.1	46.7	77.5	50.9	61.4	64.1
November	53.5	46.7	71.7	48.7	52.2	60.6
December	56.2	53.1	66.7	56.8	55.4	60.4

Source: Statistics Portugal (INE)

Figure 6
Average income (€) per night, by region



Source: own research – data extracted from Statistics Portugal (INE)

IV. Methodology

The first part of this work relies on classical (moving average) time series decomposition into trend-cycle and seasonal components. The difference between the original series and the estimated trend-cycle and seasonal effect accounts for the random or irregular components. After trend-cycle and seasonal decomposition, Winter's method is applied to relate the trend-cycle and seasonality of the data. The second part of our analysis consists of estimating linear regressions of the monthly daily rates on the corresponding seasonal coefficients and assessing how well the data fits the linear model.

A. Classic seasonal decomposition model

There are two classic models for the seasonal decomposition of time series, which are called additive model or multiplicative model. Both models rely on the estimate of a trend-cycle component through a centered moving average, with length equal to the period of the series.

The additive model is usually more suitable when the amplitude of the seasonal component is approximately constant over time. In this case, all components (trend-cycle, seasonal and random) add up to generate the original series. On the other hand, the multiplicative model is generally preferred when the amplitude of the seasonal variations of the time series change over time (as opposed to being approximately constant). In the multiplicative model, all components are factors that multiply among themselves to generate the original series. This allows us to interpret the seasonal component, as factors (or indices) that measure the relative variation (percentage) of the original time series, relative to the trend-cycle, due to seasonality.

Given that the range of the bed occupancy variable decreases over the years of the sampling period, we chose the multiplicative decomposition model:

$$x_t = \mathit{Trend\text{-}cycle}_t \times \mathit{Seasonal}_t \times \mathit{Random}_t$$

This choice will also allow us to consider seasonal coefficients to be indices (percentages).

The seasonally adjusted time series, $\mathit{Trend\text{-}cycle}_t$, will be the 12-month centered moving average:

$$\mathit{Trend\text{-}cycle}_t = \frac{1}{12} \cdot \left(0{,}5 \cdot x_{t-6} + \sum_{j=-5}^{5} x_{t+j} + 0{,}5 \cdot x_{t+6} \right)$$

The de-trended time series is:

$$y_t = \frac{x_t}{\mathit{Trend\text{-}cycle}_t} = \mathit{Seasonal}_t \times \mathit{Random}_t.$$

If the random effects are small, are good estimates of the seasonal component $\mathit{Seasonal}_t$, which is the period-12 time series of the seasonal factors. Each seasonal factor is calculated as the average of the de-trended values of the same months as , over every year in the time series. The average of the seasonal factors over 12 months is equal to 1. Finally, the seasonally adjusted time series is:

$z_t = \frac{x_t}{\mathit{Seasonal}_t}$ and the random component is $\mathit{Random}_t = \frac{x_t}{\mathit{Trend\text{-}cycle}_t \times \mathit{Seasonal}_t}$.

B. Winter's method

An exponential smoothing for series with trend and seasonality is also applied using Winter's method for hotel categories. This method sets a regression that contains a mean (μ), a slope (*b*) and seasonal coefficients (*S*), and an error term (*ε*). The multiplicative Winter's model entails a linear trend and a multiplicative seasonal parameter (*δ*), as follows:

$$\hat{Y}_t = (\mu_t + b_t t) S_{t-p} + \varepsilon_t.$$

In this equation, p is the seasonal periodicity and t is the number of periods.

Winter's model is more appropriate than other models such as simple exponential smoothing or Holt methods when data presents a trend and seasonality (Yafee and McGee 2000).

In a multiplicative model, smoothing is achieved by the division of the seasonal component into the series. Considering the mean (μ) equal to:

$$\mu_t = \alpha\left(\frac{Y_t}{S_{t-p}}\right) + (1-\alpha)(\mu_{t-1} + b_{t-1}),$$

where the coefficient alpha (α) is the smoothing weight for the equation. The slope (b) or trend is calculated as follows:

$$b_t = \gamma(\mu_t - \mu_{t-1}) + (1-\gamma)b_{t-1}$$

It includes a similar exponential smoothing as alpha of the mean equation but is now denoted as gamma (). Both smoothing weights can range from 0 to 1.

Thus, the seasonal component (S) is a portion of the ratio of the series value over the mean plus a smoothed portion of the seasonality at its periodic lag:

$$S_t = \delta\left(\frac{Y_t}{\mu_t}\right) + (1-\delta)S_{t-p}.$$

The fit of this model is measured through Mean Absolute Error (MAE = $\sum_{t=1}^{T}\frac{|\varepsilon_t|}{T}$), Root Mean Square Error (RMSE = $\sqrt{\sum_{t=1}^{T}\frac{\varepsilon_t{}^2}{T-k}}$), Mean Absolute Percentage Error (MAPE= =$\sum_{t=1}^{T}\frac{|PE_t|}{T}$). In the foregoing, ε_t are the differences between the observed values, x_t, and the forecasted ones, f_t. is the total number of observations, k is the number of parameters in the model, PE_t is the percentage error between the observed and the forecasted values.

C. Linear regression

In the linear regression equation, is the average monthly income per night (dependent variable) and (independent variable) is the corresponding seasonality coefficient:

$$Y = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \varepsilon$$

In this equation, β_t is the Y-intercept estimate and β_1 is the estimate of the coefficient for the covariate .

The ratio between the total income and the number of overnight stays is an estimator for the daily rates practiced by hotels each month. We consider whether there is a linear correlation between the income per overnight stay and the seasonality coefficient, through simple linear regressions. We examine whether the income per overnight stay (daily rate) varies in a positive linear relation to the seasonal coefficient.

In the linear regressions for Continental Portugal, as well as for each of the five NUTS II regions, we have checked the fitness degree of the linear model to the data, computed Pearson's correlation coefficient, and checked the corresponding scatter plots. As far as the residuals' requirements is concerned, we have checked among the regression statistics if the residues had zero mean. We have also checked the residues' homoscedasticity, analysing the scatter plots of the regression standardized residues against the regression standardized predicted values. The independence of the error terms was checked with the Durbin-Watson (DW) tests: we considered the error terms to be independent if the DW statistics belonged to the interval]1.5 ; 2.5 [. Finally, we have checked if the errors followed a normal distribution running Shapiro-Wilk tests, given that our samples had a small size (n=12).

V. Results

A. Seasonal decomposition and seasonality coefficients

We applied the classical decomposition model to the time series concerning net bed occupancy for hotels in continental Portugal. The graphic representation of the original series, with the superimposed trend-cycle, and the seasonally adjusted series is shown in Figure 7.

Figure 7
Monthly net bed occupancy for hotels in continental Portugal (2014 to 2019)

Source: own research – generated from Statistics Portugal dataset

We also performed the same seasonal decompositions for each of the five geographic regions in continental Portugal. The plots of the net bed occupancy rates time series according to geographical regions are shown in the Appendix. The seasonal coefficients are obtained through the same procedure, either for all hotels in continental Portugal, or for each one of the five geographical regions. Those coefficients are shown in Table 5.

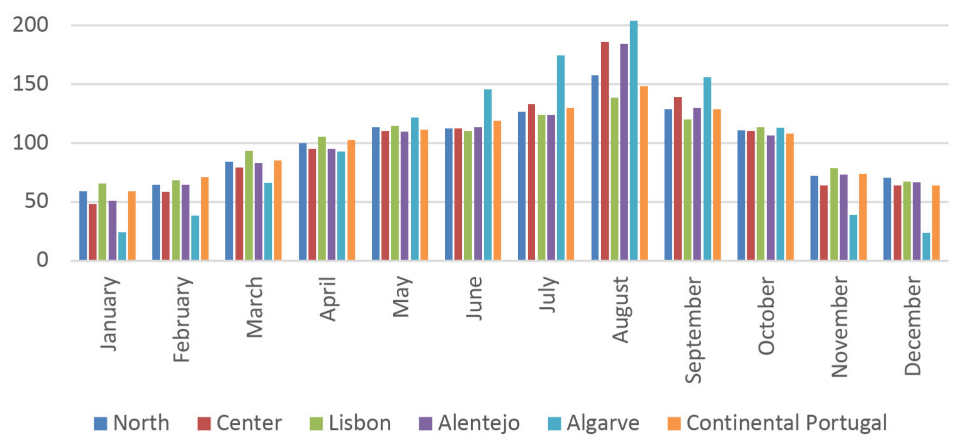
Table 5
Regional seasonal coefficients (percentage), per month, between 2014 and 2019

Month	North	Center	Lisbon	Alentejo	Algarve	Continental Portugal
January	58.9	48.3	65.8	51.1	24.3	58.9
February	64.6	58.8	68.6	64.4	38.5	70.9
March	83.9	79.1	93.3	82.9	66.1	85.2
April	100.0	95.0	105.1	94.9	93.0	102.6
May	113.7	110.2	114.6	109.5	121.9	111.2
June	112.6	112.5	110.5	113.6	145.7	119.2
July	126.5	132.9	123.7	123.6	174.5	129.8
August	157.5	185.7	138.3	184.2	203.9	148.3
September	128.7	139.1	120.1	130.1	155.8	128.6
October	110.7	110.4	113.7	106.3	113.2	108.0
November	72.2	63.8	78.8	73.0	39.2	73.6
December	70.7	64.2	67.4	66.5	23.7	64.0
Range (max-min)	98.6	137.4	72.5	133.1	180.2	89.4

Source: own research – generated from Statistics Portugal dataset

A seasonal coefficient of 100 percent means that the original time series does not differ from the seasonally adjusted series.

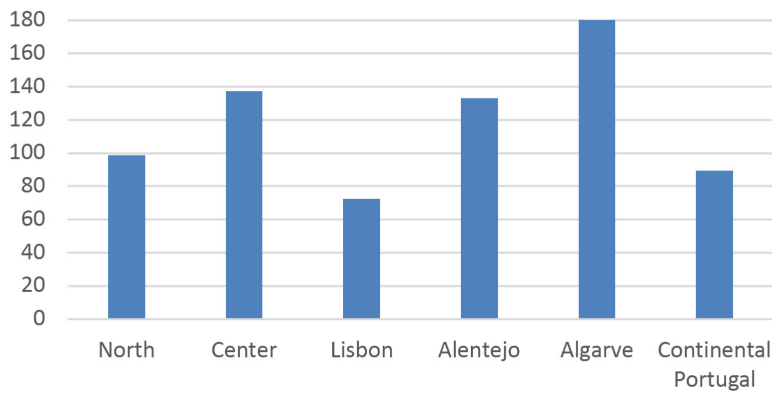
Figure 8
Seasonal coefficients according to region



Source: own research – generated from Statistics Portugal dataset

As we had mentioned, the net bed occupancy rate reaches the maximum level every August, and the minimum every January. That is reflected in the maximum seasonal coefficients in August, and minimum seasonal coefficients in January. The range of the seasonal coefficients over a 12-month period is the difference between the maximum and the minimum coefficients. We computed those ranges in Table 5 and represent them graphically in Figure 9.

Figure 9
The range of the seasonal coefficients according to geographical region



Source: own research – generated from Statistics Portugal dataset

These amplitudes allow us to compare which regions have higher variations of hotel occupancy (demand) due to seasonality throughout the year. We can see that the region of Lisbon is the one with less seasonal variation (city and business tourism), whereas the Algarve exhibits the higher variation (summer and beach destination).

The monthly seasonal coefficients according to hotel types were calculated and are shown in Table 6, together with the seasonal coefficients already calculated without hotel type distinction.

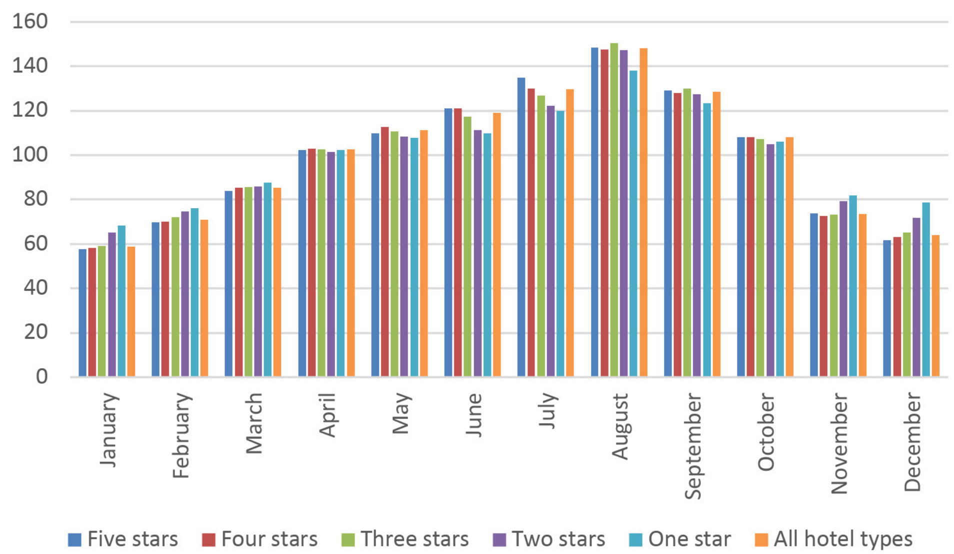
Table 6
monthly seasonal coefficients (%) by hotel type, between 2014 and 2019

Month	Five stars	Four stars	Three stars	Two stars	One star	All hotel types
January	57.6	58.3	59.0	65.0	68.4	58.9
February	69.7	69.9	72.0	74.7	76.0	70.9
March	83.8	85.2	85.5	85.8	87.7	85.2
April	102.3	103.0	102.6	101.6	102.3	102.6
May	109.7	112.7	110.7	108.5	107.8	111.2
June	121.1	121.0	117.2	111.3	109.8	119.2
July	134.8	130.0	126.9	122.1	119.9	129.8
August	148.5	147.7	150.5	147.3	138.2	148.3
September	129.2	128.1	130.0	127.5	123.3	128.6
October	108.1	108.1	107.3	105.0	106.0	108.0
November	73.7	72.7	73.2	79.4	81.8	73.6
December	61.6	63.2	65.2	71.9	78.8	64.0

Source: own research – generated from Statistics Portugal dataset

Figure 10 gives us a visual aid, and we can see that the seasonal coefficients exhibit a relatively similar variation throughout the year, independent of the hotel category.

Figure 10
Seasonal coefficients (percentage) by hotel type



Source: own research – generated from Statistics Portugal dataset

Correlation between average income per overnight stay and seasonal coefficients

From the laws of supply and demand, we would expect that the average room price is lower in the low season (lower seasonality coefficients) and higher in the high season (higher seasonality coefficients). Our proxy for the average room price is the average monthly income per night.[2]

Considering all hotels in continental Portugal, we obtained Pearson's correlation coefficient R= 0.437, which shows a positive linear correlation. Both coefficient estimates are statistically significant (), with the constant being 4.123 and the coefficient of the independent variable being 0.093. These values, as well as the corresponding linear regressions according to region can be found in Table 7.

Table 7

Linear regression coefficients according to region

		p		p	R
Continental Portugal	4.123	<.001	0.093	<.001	0.437
North	3.984	.000	0.057	.232	0.157
Center	3.837	<.001	-0.049	0.080	0.228
Lisbon	4.240	<.001	0.166	0.017	0.307
Alentejo	3.915	<.001	-0.046	0.24	0.155
Algarve	4.155	<.001	0.177	<.001	0.639

Source: own research. Note: Estimated by the Prais-Winsten method. N for each region=59

Bearing in mind that the effect of seasonal coefficients on income per overnight stay is an estimation of elasticity of income in relation to seasonality of +0.093 for continental Portugal, +0.177 for the Algarve, +0.166 for Lisbon. Thus, significant coefficients related to seasonality for different regions show that an increase of seasonality factors raises income per overnight stay (continental Portugal and the Algarve). The results suggest that in continental Portugal the elasticity of income per overnight stay in relation to seasonality factor is 0.093. In the Algarve, that elasticity is higher, and is 0.177. The regression estimation for the Algarve region shows the highest value of the correlation coefficient. This shows that in this region, where the seasonal variations of demand have a higher impact (higher seasonal coefficient amplitude), we also observe positive association in the average income per night (room rate).

The regression models for the other geographical regions (North, Center, Lisbon, and the Alentejo) showed a correlation coefficient of less than 0.5. Several coefficients (namely) were not statistically significantly different from zero (),

[2] A preliminary scatter plot and OLS regression line of the average monthly income per night according to seasonality coefficient (for continental Portugal) is shown in the Appendix III, Figure 16.

which would mean that that model would be a constant function (the average room income does not vary according to seasonality). That is not the case in Lisbon, for instance, which is the region where the seasonality coefficient is significant.

An alternative measure of correlation is given by the Spearman correlation coefficient, which clarifies the evidence of the existence of a positive correlation between the variables of net bed occupancy rate and hotel income. The correlation coefficients between the net bed occupancy rate of three-star hotels and two--star hotels and their income are stronger than other cases. Even the dependency between occupancy rate and income is stronger for three-star hotels than for any other hotel type. As far as region is concerned, hotels in the Algarve, regardless of their type, show the highest correlation between net occupancy and income.

Robustness check

We performed a seasonal analysis where a time-series seasonal component is studied, the seasonal factors are computed and detailed by all hotels, or by hotel type and region. The detailed seasonal coefficients are obtained through the method of decomposition of the series of overnight stays by region. Meanwhile, the trend-cycle of net bed occupancy rates was explored through the estimation of a regression line of the main variable under study using the month as an independent variable. It is known that the coefficient of the time variable determines the direction of the trend-cycle, that is, if it is increasing (>0) or decreasing (<0).

For a robustness check, we used Winter's method for continental Portugal and all hotel types. The application of Winter's method generated the coefficients of regression models that set the component parts of the times series for each type of hotel (seasonal, trend-cycle and mean) and these are presented in the appendix, and it shows evidence that the seasonal coefficients are significant for all hotel types. The estimate of the season component is higher for all hotels assembled, despite the different and low estimates for each type of hotel. In this method, 4-star hotels present the highest season component, contrasting with the different results of the decomposition method. For each type of hotel, the trend component has no statistical relevance.

VI. Conclusion

In this study, we analyzed time-series datasets from Statistics Portugal, concerning net bed occupancy rates for hotels in continental Portugal, in the period from 2014 to 2019, which was before the outbreak of the COVID-19 pandemic. We performed a classic decomposition into trend-cycle and seasonal components, according to the multiplicative model and calculated the seasonal coefficients for hotel demand in continental Portugal. We also carried out similar calculations for hotels in different geographical regions, and for all hotels of each type.

We found that the highest seasonality coefficient in continental Portugal always occurs in August, whereas the lowest always occurs in January. Data between 2014 and 2019 shows a slight increasing trend-cycle for the net bed occupancy rates for all hotels in continental Portugal. As far as hotel type is concerned, we found that five-star to two-star hotel types showed a steadily increasing trend-cycle, whereas one-star hotels did not show such an increasing trend-cycle.

Additionally, we considered the correlation between average income per overnight stay and net bed occupancy rate to assess whether hotels adjust their room fares according to demand (seasonality). We reached the conclusion that globally, in continental Portugal, there is a correlation between these variables, which shows that room rates tend to increase when seasonality factors increase. The region with the highest seasonality effects is the Algarve, and this is the region where the correlation between average monthly income per overnight stay and seasonality coefficient is highest, and where the regression model shows a better fit to the data. On the other hand, in the Lisbon region, the amplitude of the seasonal coefficients throughout the year is smaller (among the significant coefficients), which shows a smaller seasonality effect, typical of city tourism.

Finally, regarding future research, it would be valuable to compare current seasonality coefficients, that is, in the post-pandemic period, to the ones we estimated for the pre-pandemic period. Additionally, it would be interesting to reassess the correlation between the income per overnight stay and the seasonality coefficients in the recovery period after the COVID-19 pandemic, and perhaps consider a more direct metric for the average room rate, instead of an indirect metric such as the one we considered. However, average room rates are a complex matter, given the existence of hotel booking platforms offering the same hotel rooms at different rates, therefore such future research could benefit from some additional data and model complexity.

Appendix I – Complementary tables

Table 8
Net bed occupancy for hotels in continental Portugal

	2014	2015	2016	2017	2018	2019
January	23.8	27.1	28.4	31.7	32.3	32.1
February	28.2	32.0	34.8	38.5	39.3	37.7
March	35.6	38.6	44.6	44.0	46.7	45.5
April	47.5	48.5	49.4	59.0	53.7	56.1
May	51.3	54.5	56.8	59.6	59.1	58.8
June	53.4	57.5	61.4	65.0	62.4	62.9
July	60.3	63.9	67.4	68.9	66.4	65.4
August	73.8	75.4	76.3	77.3	75.6	74.9
September	61.6	63.8	66.7	69.2	67.0	66.3
October	49.8	52.2	56.8	59.0	57.6	56.8
November	33.0	34.6	39.0	41.3	41.3	42.4
December	29.5	31.2	33.3	36.2	35.2	36.7

Source: Statistics Portugal (INE)

Table 9
Average monthly net bed occupancy, according to hotel type

	Five Star	Four Star	Three Star	Two Star	One Star
January	31.3	31.2	26.1	25.8	27.1
February	37.8	37.3	31.9	29.5	30.9
March	45.8	45.9	38.0	34.2	35.1
April	56.8	56.7	46.9	41.4	41.6
May	61.0	61.9	50.5	44.0	44.1
June	67.4	66.1	53.3	44.6	43.6
July	74.4	70.8	57.4	49.0	48.1
August	83.2	80.9	68.5	59.4	55.8
September	72.1	70.7	59.5	51.6	49.6
October	60.5	59.7	49.8	43.3	43.0
November	42.1	40.7	35.2	33.2	33.6
December	35.4	35.7	30.8	30.0	31.9

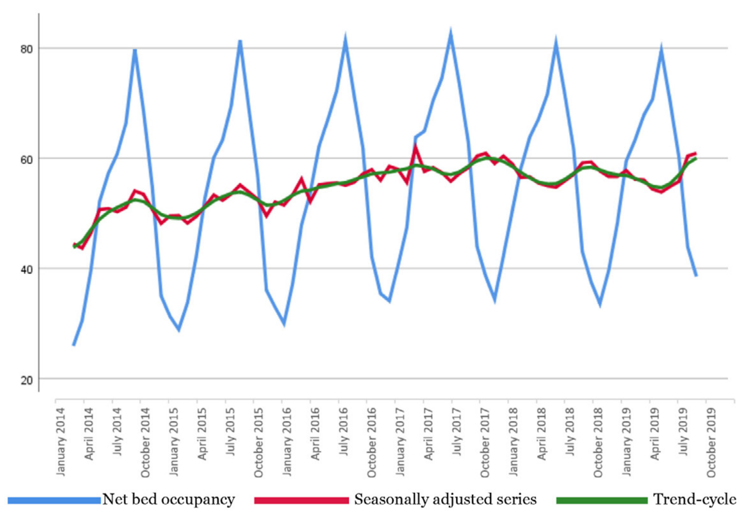
Source: Own research, data from Statistics Portugal (INE)

Appendix II – Seasonal decomposition plots by hotel type

Figure 11
Monthly net bed occupancy rate (2014 to 2019) for 5-star hotels

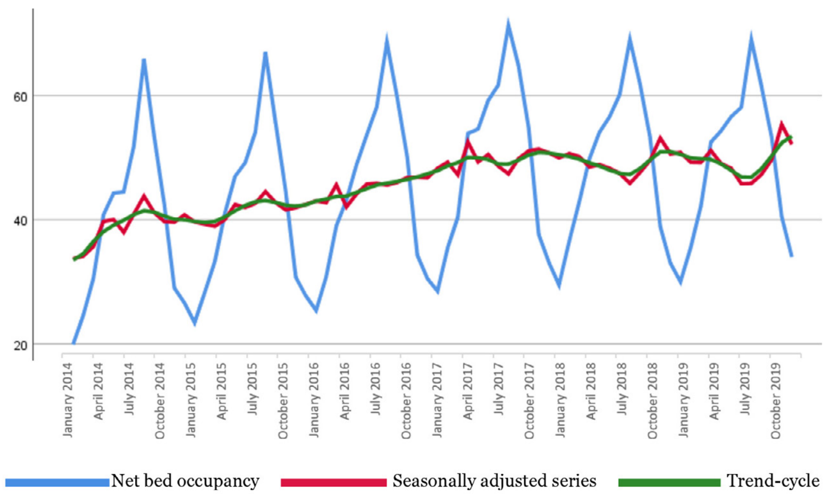
Source: own research – generated from Statistics Portugal dataset

Figure 12
Monthly net bed occupancy rate (2014 to 2019) for 4-star hotels



Source: own research – generated from Statistics Portugal dataset

Figure 13
Monthly net bed occupancy rate (2014 to 2019) for 3-star hotels



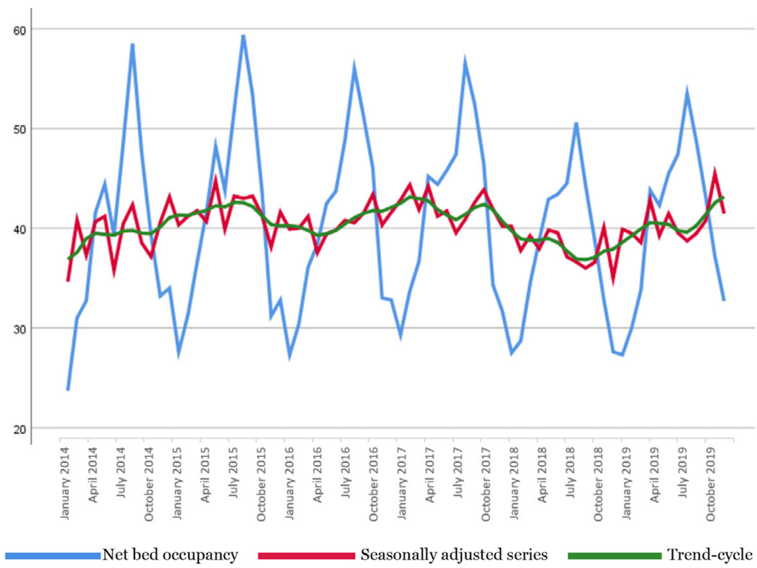
Source: own research – generated from Statistics Portugal dataset

Figure 14
Monthly net bed occupancy rate (2014 to 2019) for 2-star hotels

Source: own research – generated from Statistics Portugal dataset

Figure 15

Monthly net bed occupancy rate (2014 to 2019) for 1-star hotel

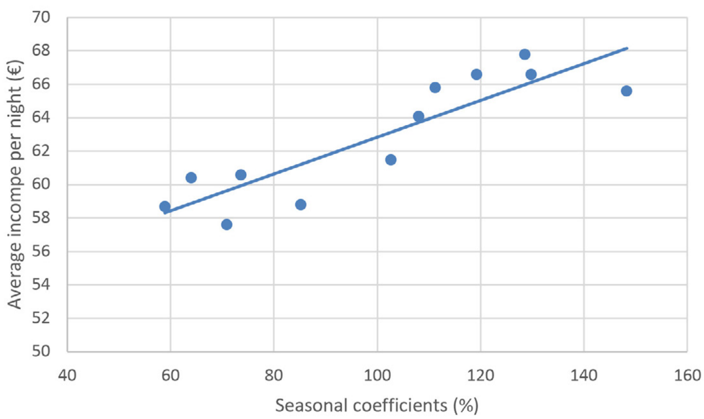


Source: own research – generated from Statistics Portugal dataset

Appendix III – Income per overnight stay

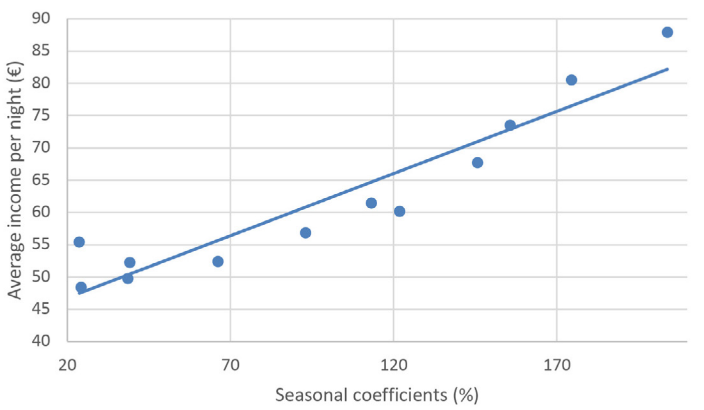
The following scatter plots consist of twelve points, one for each month, where the dependent variable is the average income per overnight stay, and the dependent variable is the seasonal coefficients. The straight lines are the ordinary least squares linear regression lines for the twelve observations (points).

Figure 16
Average monthly income per night according to seasonality coefficients



Source: own research – data extracted from Statistics Portugal (INE)

Figure 17
Income per night, according to seasonal coefficient, in the Algarve



Source: own research – generated from Statistics Portugal dataset

Appendix IV
Linear regression complementary tests

Table 10
Winter method – Model Parameters

Model			Estimate	SE	t	Sig.
Hotels – net bed occupancy rate-Model_1	No Transformation	Alpha (Level)	.144	.049	2.932	.005
		Gamma (Trend)	.009	.040	.230	.819
		Delta (Season)	.935	.131	7.127	.000
5*-Model_2	No Transformation	Alpha (Level)	.053	.012	4.470	.000
		Gamma (Trend)	.810	.177	4.584	.000
		Delta (Season)	.516	.097	5.316	.000
4*-Model_3	No Transformation	Alpha (Level)	.130	.043	3.050	.003
		Gamma (Trend)	.010	.036	.293	.770
		Delta (Season)	.922	.128	7.205	.000
3*-Model_4	No Transformation	Alpha (Level)	.203	.051	4.005	.000
		Gamma (Trend)	.006	.020	.284	.777
		Delta (Season)	1.000	.133	7.544	.000
2*-Model_5	No Transformation	Alpha (Level)	.184	.056	3.302	.002
		Gamma (Trend)	.003	.015	.208	.836
		Delta (Season)	.682	.130	5.256	.000
1*-Model_6	No Transformation	Alpha (Level)	.291	.080	3.652	.001
		Gamma (Trend)	.001	.045	.022	.982
		Delta (Season)	.360	.153	2.354	.021

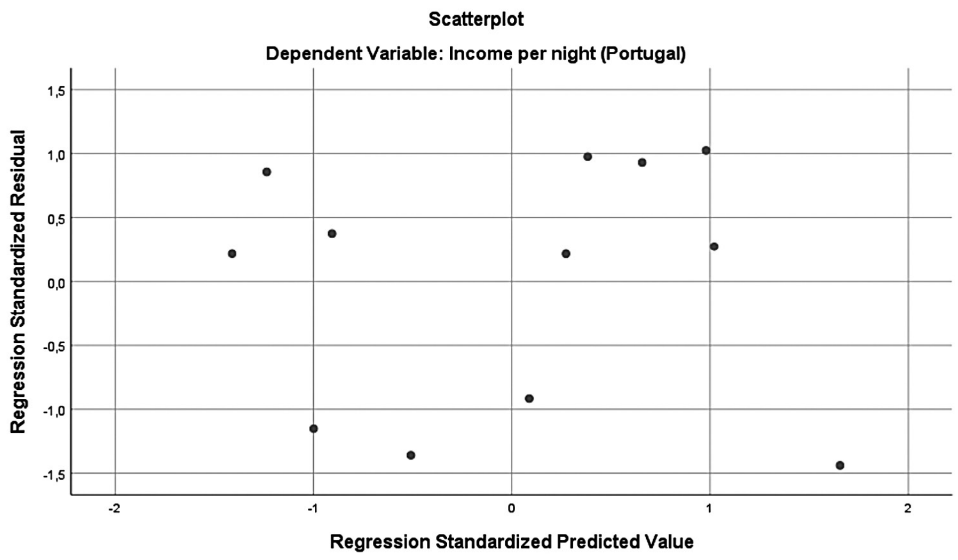
Source: own research (SPSS output)

Table 11
Durbin-Watson independence test and Shapiro-Wilk normality test for the linear regression error terms

	Durbin-Watson	Shapiro-Wilk
Continental Portugal	1.604	.035
North	1.339	.345
Center	1.333	.814
Lisbon	1.512	.588
Alentejo	1.347	.825
Algarve	.907	.691

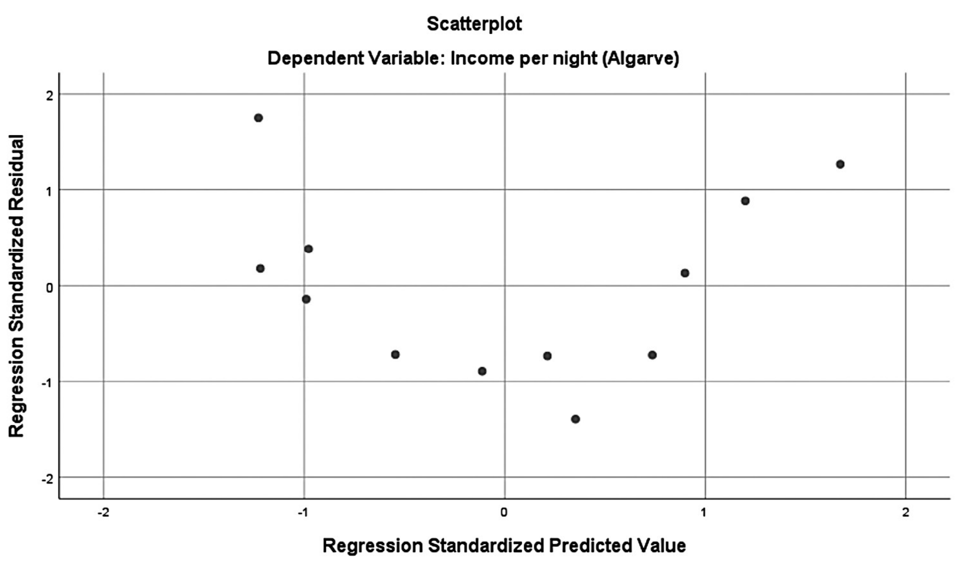
Source: own research (SPSS output)

Figure 18
Homoscedasticity of the residuals for Continental Portugal



Source: own research (SPSS output)

Figure 19
Homoscedasticity of the residuals for the Algarve region



Source: own research (SPSS output)

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